Technical Specification for Ultra High Resolution Electron Beam Lithography System

1.

S.No	Bidder Eligibility Criteria:	Compliance (Yes/No)	Reference Page No.
1	Purchase order copies should be provided for at least 3 installations in India in reputed institutions (IITs, IISc, and Govt. laboratories) of the same model being quoted in the last 5 years. Contact person Name, Email Id., Phone no. & Institution Name should be provided of the quoted model for electron beam lithography tools & should be attached along with the technical specifications.		
2	Service center should be in India.		

2.

a) **Main System**

In general system should be able to perform High resolution imaging and pattern writing.			
S.No	**Features**	**Compliance (Yes/No)**	**Reference Page No.**
1. Electron optics system	1.1. Thermal field emission (TFE) Schottky source. Emitter should have lifetime > 8000 hours. 1.2. Fully digital electron optics column, beam energy selectable between 50 eV - 30 keV of higher. 1.3. User defined write fields from 0.5 μm to 2 mm with automated calibration. 1.4. Beam spot size: <2 nm at 20 kV. Specify the spot size at other operating volatges. 1.5. User should be able to modulate the beam current from 8 pA or less to 20 nA or higher for writing different size features. 1.6. It should have integrated Faraday cup and internal or external Pico-Ammeter to measure the beam current. Beam current stability: ≤ 0.5% in 1 hour (at room temperature ±0.5°). 1.7. Detectors: It should have SE Detector and in-lens (also known as in-beam) SE Detector. 1.8. Magnification from 20X to 1,000,000 X times. 1.9. System should be able to resolve and take images of feature size of 2 nm or better during scanning imaging mode.		
2. Stage and chamber	2.1. 50 mm x 50 mm (or higher) travel range with 2 nm XY positioning resolution (or better) at any working distance and write field size (magnification). It should have laser		

	interferometer controlled stage to achieve the positioning resolution of 2 nm or better for entire 50 mm x 50 mm travel range. 2.2. 25 mm or higher travel in Z. 2.3. Built-in infrared camera system with optics for visual control and orientation purposes. 2.4. Dry vacuum pump system for oil-free chamber vacuum. The base pressure in the specimen chamber should be better than $2x10^{-6}$ mbar and inside the column it should be better than $1x10^{-8}$ mbar. Vacuum status, vacuum readings and valve position should be visible in the main menu. 2.5. Should provide sufficient length of the pumping lines so that pumps can be kept at a distance from the lithography machine to reduce the mechanical vibration and noise. All vacuum systems should be controllable through software user interface and with adequate safety interlocks. 2.6. Anti-vibration platform or table should be provided with the machine.		
3. Integrated sample rotation and tilt function	3.1. Fully integrated motorized arrangement for rotating and tilting all sample holders. 3.2. Tilt angle 0 - 90 degrees. 3.3. Rotation 360 degrees. 3.4. Full software control with software suite (digital motion, position recall, homing and initialization for tilt and rotation). 3.5. Manual control using joystick controller. 3.6. Allows for compucentric mode operation.		
4. 2-inch wafer holder	4.1. Suitable substrate holders to hold full 2 inch silicon wafer and smaller dimensions samples should be provided. 4.2. It should have 45° and 90° sample mount for cross sectional imaging. 4.3. 2 or more clamps for sample mounting. 4.4. A suitable holder to hold 2.5 inch mask plate should also be provided.		
5. Scan Generator and beam blanker.	5.1. 6 MHz or higher speed scan generator. 5.2. It should have a fast electrostatic beam blanker with a rise time of 50 ns or smaller.		

6. Uninterrupted Power Supply	6.1. Autonomy time: >30 min (100% load). 6.2. Software Integrated and controlled system shut down when critical time for main power off is reached.		
7. Other hardware	7.1 Should be supplied with Electron beam lithography starter kit. 7.2 Should be supplied with system water chiller (closed circuit).		
8. Software	8.1 System control software with true multi-user management interface, user specific log-in and system/process parameter administration. 8.2 Inspection software (including GDSII layout based sample navigation) with image archiving. 8.3 Dimensional metrology software. 8.4 Integrated professional GDSII editor with large file handling capabilities. 8.5 Multilevel lithography & Mix and Match lithography support with marks of arbitrary shape (including 2D mark recognition algorithm based on FFT). 8.6 Grey scale bitmap import with GDSII conversion for 3D-Lithography. 8.7 Master users advanced exposure software including multi-directional patterning modes (e.g. angle, transversal, longitudinal, concentric, raster, loops and submodes, macro editor, script control, recipe manager and column parameter access (option). 8.8 It should have proximity error correction, parameter determination and 3D resist profile simulation capability. 8.9 A suitable high end computer with Windows 10 or Higher, 32 GB RAM, 2TB SSD, i7 or higher processor with 28 inch or bigger monitor should be provided. Keyboard, mouse along with MS Office should also be included. 8.10 A licensed version of the lithography and CAD software to install on an off-line PC should be provided. The CAD file editor should support GDSII and DXF formats. Upgrades and updates for the software should be available free of-cost for three years after installation. 8.11 SW upgrades has to provided free of cost for 5 years from the date of installation.		
9. Lithography specifications	9.1. Minimum feature size: $\leq$ 10 nm. 9.2. Minimum pitch: 50 nm spacing in case of array of lines of 20 nm width.		

	9.3. Field stitching ≤ 70 nm. 9.4. Overlay accuracy alignment: ≤ 70 nm. 9.5. Vendor must provide a detailed description of measurement procedures for above given lithography specifications.		
10. On-Site Training 7 days	10.1 Installation and training should take place at IIT Madras site. The expenditure involved in it will be borne by the supplier. On site application training for minimum 3 days by the company designated factory trained application scientist for a group of technical staff/students for operating the instrument to complete structure determination/solution including software learning. 10.2 Every year (up to 5 years) 2 days of Application training should be conducted to refresh the knowledge and to train new users during the warranty period.		
11. Other specifications	11.1 Shipment should include all auxiliaries to run the system including an Uninterrupted Power Supply (UPS). 11.2 Should provide all the required tools for the routine operation & maintenance of the machine, substrate mounting etc. Printed version of the operation and maintenance manuals for the system and all the third party components attached to the system, such as pumps, vacuum valves, power supplies etc. 11.3 Should include the cost of consumables and spares such as FEG tip, aperture, gaskets, O-rings for the smooth functioning of the system for 5 years.		
12. Warranty	A minimum of 5 years comprehensive warranty for the equipment (including all spares, accessories and third party items including UPS) should be provided.		
13. Down-time call attendance	Supplier should clearly mention about their service set up in India for prompt service support along with contact details of service engineers specially trained on the offered system. Service should be provided at earliest and 24 X 7 online support.		
14.Preparatory work to be done for installation	Complete technical details of pre-installation requirements should be furnished along with the technical bid. Vendor should complete the installation site survey (for EM noise, acoustic and floor vibration measurements & computer analysis of impact on system performance; supply check) within 15 days of the receipt of the purchase order.		

15. Installation requirement	The instruments will be considered successfully installed only upon the demonstration of the following at IIT Madras: The lithographic capabilities and specified feature sizes should be demonstrated on-site. Detailed recipe for achieving the minimum feature size should be provided. The processing of the wafers such as spin coating and baking of the resists, developing the patterns after the exposure should be done on-site. Minimum feature size (isolated lines of 10nm) and pitch (50nm) as mentioned in point 11 of this document.		

b) Optional Items:

1. Other detectors	Combined in-lens SE and BSE detector, (2) post-lens angle selective BSE detector, (3) EDS detector, Boron to uranium or more and capable of doing qualitative, quantitative analysis and mapping.		
2. Higher speed scan generator	Quote for higher speeds scan generator (12 MHz and 20MHz).		

(Note: It is mandatory for the bidders to provide the compliance statement in tabular column format along with catalogue page number (comply/not comply) for the Above points with document proof as required. Failing which bidders will be technically disqualified)